6.0 SUMMARY OF CLEANUP ACTION ALTERNATIVES

6.1 Remedial Action Objectives

The Site remedial action objectives are intended to protect human health and the environment by eliminating, reducing, or otherwise reducing risks posed through exposure pathway and migration route at Deposits 1 and 2. They are developed considering the characteristics of the contaminated sediment and the hazardous substances present, migration and exposure pathways, and potential receptor points.

Consistent with the conceptual model developed for the Site (Anchor 2004), along with Ecology guidance, this FCAP considered four interrelated remedial action objectives for the Upriver Dam Site:

1. Control of benthic exposure to PCB-contaminated sediments located within the biologically active sediment zone (defined in the RI as 0 to 10 cm below mudline).
2. Minimization of benthic exposure to PCB-contaminated subsurface sediments (i.e., located more than 10 cm below mudline), considering sediment stability under potential future conditions.
3. Reduction of potential remobilization of PCB-contaminated sediments by hydraulic or other physical processes.
4. Reduction of potential transport (flux) of PCBs into the overlying water column and groundwater.

6.2 Cleanup Action Alternatives

The Focused Feasibility Study (FS) Report presented remedial technologies and process options that are potentially applicable to Deposit 1 and 2 Site sediments. The Report evaluated those technologies based on initial MTCA screening criteria including effectiveness, implementability and cost of application to the Site. It then combined the technologies to formulate the following four remedial action alternatives which span the range of potentially feasible response actions typically available for sediment sites.

Alternative 1 - Monitored natural recovery
Alternative 2 - Enhanced natural recovery
Alternative 3 - Engineered sediment capping
Alternative 4 - Removal, off-Site disposal and residuals capping

A brief summary of each of these alternatives is presented below and graphically illustrated in Figure 5.

6.2.1 Alternative 1 – Monitored Natural Recovery

Monitored natural recovery (MNR) is a risk management alternative that relies upon natural environmental processes to permanently reduce exposure and risks associated with contaminated sediments. This alternative relies on sediment deposition (burial) and contaminant attenuation processes. Any necessary upstream source controls for PCBs would need to be implemented under existing wastewater discharge permits and future total maximum daily loading (TMDL)

allocation-based limits. The effectiveness of MNR would be verified through long-term monitoring.

6.2.2 Alternative 2 – Enhanced Natural Recovery

This alternative relies on MNR processes but enhances the natural recovery rate with the placement of a nominal 6-inch (15 cm) layer of clean, fine to medium grained sand over sediments that exceed the cleanup level of 62 µg/Kg dw. Placement of this thin layer on the existing sediments would facilitate attainment of the cleanup level within the top 10cm biologically active zone. Compared with thicker sediment caps, application of thin-layer placement technologies is typically associated with less short-term environmental impact, as existing sediment-dwelling benthos populations are able to migrate through the 6-inch layer with relatively little mortality. As is true for MNR, any necessary upstream source controls for PCBs would be implemented under existing wastewater discharge permits and future TMDL allocation-based limits. The effectiveness of enhanced natural recovery would be verified through long-term monitoring, though fewer monitoring events would be required to verify attainment and maintenance of the cleanup level compared with the MNR alternative

6.2.3 Alternative 3 – Engineered Sediment Capping

These alternatives involve the placement of various materials over areas of the Site that exceed the sediment cleanup level of 62 µg/Kg dw Long-term monitoring, maintenance, and adaptive management of the cap surface, including repair, would be performed as part of this alternative to ensure the long-term integrity and performance of the cap system. Any necessary upstream source controls for PCBs would be implemented under existing wastewater discharge permits and future TMDL allocation-based limits

Five alternative sediment cap designs were considered by Ecology. Each design includes a surface erosion-protection layer and an underlying isolation layer; some designs include a "reactive" layer. Each cap design:

- physically isolates PCB-contaminated sediments below the biologically active zone (10 cm thick benthic environment);
- further stabilizes subsurface PCB-contaminated sediments from potential worst-case hydrodynamic forces (i.e., erosion protection); and
- reduces the transport (flux) of dissolved PCBs into the overlying water column.

The five alternative reactive-barrier cap designs are as follows:

A) a nominal 12 inch layer of sand overlain by a 3 inch layer of appropriate gravel armor cover;

B) a 6 to 12 inch gas venting (sand) layer overlain by a nominal 6 inch layer of AquaBlok™, and covered by an additional 3 inch layer of gravel armor;

C) a 6 to 12 inch gas venting layer overlain by a nominal 18 inch layer of AquaBlok™, and covered by an additional 3 inch layer of gravel armor;

D) a nominal 6 inch layer of granular bituminous coal overlain by a 6 inch layer of sand and covered by an additional 3 inch layer of gravel armor; or

E) a nominal 18 inch layer of granular bituminous coal overlain by a 6 inch layer of sand and covered by an additional 3 inch layer of gravel armor.

Gravel armor composes the surface erosion-protection layer and would be designed to protect the cap from erosion during a 100-year flood event. Different materials and thicknesses were considered for the cap isolation layer in order to prevent future groundwater/porewater transport of PCBs into the surface sediment biologically active zone. Relative to substantially inert sand, more "reactive" materials were considered in some of the alternative cap isolation layer designs, providing for further adsorption and mobility controls (sequestering) of PCBs from sediment porewater. The "reactive" layer materials may be constructed of regionally available granular bituminous coal or AquaBlok™, a commercial product consisting of gravel, clay minerals, polymers and other additives.

6.2.4 Alternative 4 – Removal, Off-Site Disposal and Residuals Capping

This alternative involves the removal and off-Site disposal of sediments exceeding the sediment cleanup level of 62 µg/Kg dw. Estimated excavation/dredging depths range from 2 to 3.5 feet for Deposit 1. Some of the dredged sediment would require passive dewatering before disposal, with the runoff requiring treatment prior to discharge. In Deposit 1, the presence of woody debris, boulders and other potential obstructions would likely impede dredge efficiency, resulting in a thin layer of residual PCB-contaminated sediment that would remain in the dredge area. Accordingly, dredge residuals will likely require covering with a backfill/sand cap. The post-dredge cap would prevent exposure of the residual PCBs to the biologically active zone or water column and would also restore existing grades. Because of its backwater location (Figure 3), excavation of the Donkey Island, Deposit 2, sediments could be accomplished by first isolating this area from the Spokane River by placement of a small sand dam. The isolation dam would control water quality releases associated with excavation within this area. The effectiveness of the dredge/excavation and cap remedies at Deposits 1 and 2 would be verified through sediment and water quality monitoring. Any necessary upstream source controls for PCBs would need to be implemented under existing wastewater discharge permits and future TMDL allocation-based limits for PCBs that are currently under development by Ecology.